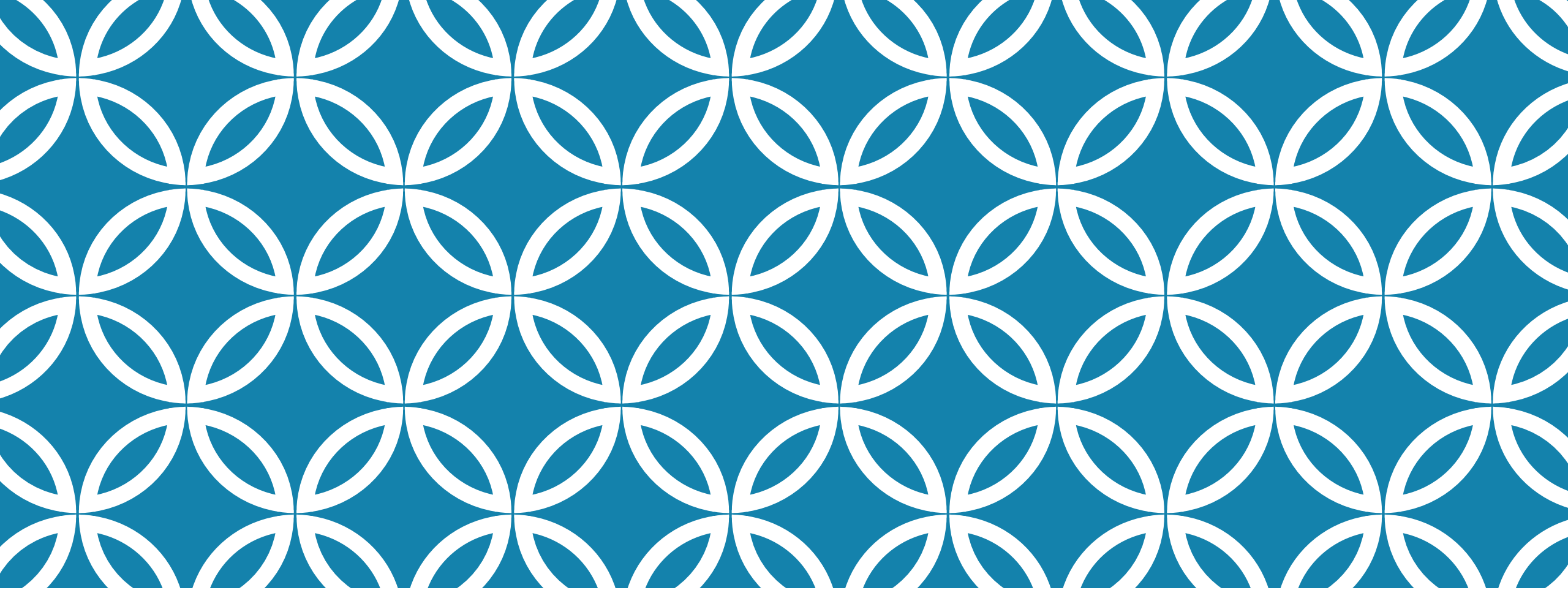

IAL EDEXCEL UNIT 6 (PART 2)

THIRD SECTION EXPERIMENTS

METHODS (10 MARKS)

Marks **divided into the following portions:**

- Independent Variable **(1 mark)**
- Dependent Variable **(1 mark)**
- 2 control variables and how they are controlled **(4 marks)**
- Experiment procedure **(4 marks)**

1) INVESTIGATION TO DISCOVER THE MINIMUM CONCENTRATION OF ETHANOL THAT IS NEEDED TO INHIBIT THE GROWTH OF SPECIFIC TYPE OF BACTERIUM.

A) A CONSIDERATION OF SAFETY ISSUES AND HOW YOU WOULD MINIMISE THE RISK.

Alcohol is flammable/irritant

Keep alcohol away from naked flames

Need to prevent growth of harmful bacteria

Aseptic conditions needed

Use of a stain of bacteria that is not harmful

B) PRELIMINARY WORK (WORK BEFORE EXPERIMENT TO ENSURE IT WORKS)

Practice proposed method before hand **(ALWAYS CORRECT FOR ALL PRELIMINARY WORK)**

Check most suitable conditions for growth of the bacteria

Select suitable timescale for measuring growth of bacteria

Check method of measuring effect on growth of bacteria

Consider what other variables need to be taken into account

Determine a suitable concentration range for alcohol

C) METHOD (10 MARKS)

Dependent variable is inhibition of bacteria **(1 mark)**

Independent variable is concentration of alcohol **(1 mark)**

Range of concentration suggested 20%, 40%, 60%, 80%, 100%

A clear description of how the alcohol will be added to the bacterial culture **(pour different concentration of alcohol into separate disc)**

Need for **nutrient gel/ nutrient broth** for bacteria to grow

Some clear consideration of **period over which the growth will be measured**

Type of bacteria to use/ **E-coli**

Identification of up to two other variables that could affect growth of bacteria (**pH and temperature) (2 marks)**

Description of how these two identified variables can be controlled. (**pH by using buffer and temperature using an incubator) (2 marks)**

Needs for repeats at each concentration (ALWAYS REPEAT)

How the bacteria culture will be set up e.g. **Lawn, inoculation of broth**

D) RECORDED, PRESENTED AND ANALYSED:

Draw a **graph** or you could draw the **table.**

Find the change in bacterial growth calculated e.g. by **measuring area of zone of inhibition/ absorbance of culture.**

Means calculated from repeat data

Graph type selected that matches the data to be collected **(line graph; Area of inhibition against alcohol concentration)**

Use of **correlation test (Spearman's Rank).**

Find the **optimum pH**

E) LIMITATIONS OF PROPOSED METHOD

Difficult to control all variables (Correct 70% of the time)

Uneven spread of bacteria at start

Need to test effect on more than one type of bacteria

Experimental conditions do not match use of hand wash

2) INVESTIGATION TO DETERMINE WHETHER FREQUENCY OF PARTICIPATION IN YOGA CLASSES IS LINKED TO AN INCREASE IN VITAL CAPACITY. (SO RELATING TO SPIROMETER)

Vital Capacity: The greatest volume of air that can be expelled from the lungs after taking the deepest possible breath.

A) SAFETY AND ETHICAL ISSUES

Safety

- Risk of injury
- Risk of infection from mouth pieces
- Exposure to soda lime

Ethical

- Participants give consent or are volunteers
- Participation with health issues should not take part

B) PRELIMINARY WORK

Practise proposed method to see if it work

Type of yoga exercise

Standardising participants

Determining timescale for measureable effect (on VC)

C) EXPERIMENT

Clear statement of **independent variable** as number of yoga classes attended per week

Suitable number of values for **IV (Independent Variable)** – at least 5 per unit time

Idea of a group not doing yoga

Dependent variable as VC (Vital Capacity)

How a value for VC will be measured

e.g. calibrate spirometer difference between peak and trough for a deep breath on a spirometer

Three variables that should be controlled e.g. **age, gender, BMI, State of health**

Repeat measurements for each person

Multiple people for each value of the IV

D) RECORDED, PRESENTED AND ANALYSED

Draw a table

Draw a line graph

Use spearman's rank to find significance of correlation

E) LIMITATION

Difficult to control all variables affecting Vital Capacity (SEE AGAIN)

Genetic variability, previous history of yoga

Idea that participants will differ in their effort

Idea that there may be a 'ceiling' on an individual's Vital Capacity, even with training

Idea that **accurate measurement of VC** is reliant on the subject exhaling fully

Idea that the results may not be representative of all individual

3) INVESTIGATE ABUNDANCE OF PRIMROSE PLANTS WOULD INCREASE WITH AN INCREASE IN LIGHT INTENSITY

A) SAFETY AND ETHICAL ISSUE

Safety

- Possible risk from indigenous animals e.g. Snakes
- Unidentified plant

Ethical

- Minimizing the disturbance of the habitat

B) PRELIMINARY WORK

Practice method to see if it works

Check for the most suitable size of quadrat to use

Select suitable area for sampling

Standardising light measurements

Consider what other variables need to be taken into account **(Also the most frequent answer)**

C) EXPERIMENT

Dependent variable: percentage ground cover of primrose

Variable to be controlled:

- Gradient of slope – through choice of site
- Other surrounding vegetation – Remove other vegetation during selection of quadrat area

1m x 1m size of quadrat

Mark 100m x 100m grid and use random number tables or use dice

Mark each plot for sampling and measure light intensity several times during the day

Select suitable equipment to measure light intensity e.g. light meter

Repeat

D) RECORDED, PRESENTED AND ANALYSED

Plot data on to a table

Means calculated from repeat light intensity area

Scatter graph of x axis (Light Intensity) and y axis (Mean percentage area covered by primrose)

Spearman's rank to check correlation

E) LIMITATION

Difficult to control all other factors affecting primrose abundance

Recognition that light intensity can change during sampling

Angle of sun changes during the day

Age/ stage of primrose would affect %cover

4) INVESTIGATION TO FIND THE OPTIMUM CONCENTRATION OF MG^{2+} IONS

A) SAFETY AND ETHICAL ISSUES

No significant ethical issues

No significant safety issues

Some might be allergic to mineral ions

B) PRELIMINARY WORK

See if proposed method works

See if plant chosen will grow in hydroponics

Selecting range of Mg concentration

Measure mass

Check most suitable condition

Select suitable timescale for experimentation

C) EXPERIMENT

Dependent Variable: Mass of plant – Using balance

Independent Variable: Concentration of Mg ions – Range concentration suggested minimum of 5

Control variable – Light, other mineral concentration…

Replica for each concentration

Use of same species

Use of graph to identify optimum concentration

D) PRESENTED, RECORDED AND ANALYSED

Table drawn

Means calculated

Line graph used

Identify optimum concentration

E) LIMITATION

Difficult to control all variables affecting plant growth

Genetic differences between the plants

Limiting factor

Need for more than one type of mineral for growth effectiveness

Difficulty in measuring dependent variable

5) CHECK THE RELATIONSHIP BETWEEN DENSITY OF PARSNIP AND GROWTH OF PLANT

A) SAFETY AND ETHICAL ISSUES

Need some form of systematic sampling to provide a suitable range of distances seeds placed apart from each other

Dangerous animals

Ethical considerations in growing parsnip seedlings

B) PRELIMINARY WORK

Practice method/ See if method will work

Check most suitable conditions for growth of parsnip seeds

Select suitable timescale for measuring germination

Identify other variables that need to be taken into account

Use same source of parsnip seeds

Dependent variable determined

C) EXPERIMENT

Dependent variable: mass of parsnip – Using balance

Independent variable: densities for parsnip seeds – Sowing density

Same source to reduce variation

Suitable medium to germinate seeds (moist cotton wool)

Time period over which the seeds will be measured

Two controlled variables

Repeat

D) RECORDED, PRESENTED AND ANALYSED

Table with mean calculated

Use of Spearman's Rank for correlation

E) LIMITATION

Difficult to control all factors

Impossible to control natural variation of seed

Timing of germination may be erratic

Measuring germination does not necessarily correspond to yield of crop

Controlled conditions may not represent natural growing conditions

6) INVESTIGATION TO COMPARE THE ANTIBIOTIC PROPERTIES OF THE SECRETIONS FROM TWO DIFFERENT SPECIES OF MANTILLA FROG

A) SAFETY AND ETHICAL ISSUES

Frogs should be kept in suitable conditions

Return frogs to the wild

Avoid skin contact with frogs

Need to prevent growth of harmful bacteria

B) PRELIMINARY WORK

Practice proposed method

Solution of appropriate species of frog

Carry out experiment to determine a suitable method for collecting secretions from frog

Carry out experiments to determine appropriate concentration of frog secretion

Carry out experiment to determine the most appropriate method for applying the secretion to the plate

Determine best method of measuring dependent variable

C) EXPERIMENTS

Dependent variable: Zone of inhibition

Independent variable: Secretion from different frogs

Description of how secretions will be added to the bacterial culture

Need for nutrient gel

Time period over which the growth will be measured

Selection of type of bacteria

Control variable

Repeats

D) RECORDED, PRESENTED AND ANALYSED

Table

Change in bacterial growth calculated e.g. by measuring area of zone of inhibition

Means calculated from repeat data

Bar graph

T-test, Mann-Whitney U test

Action taken to deal with anomalous data

E) LIMITATIONS

Difficult to control all variables affecting bacterial growth

Other components of secretions may affect

Difficult to standardise extraction of secretion

Age, Size and Gender

Uneven spread of bacteria

Variable that maybe acting as a limiting factor for bacterial growth

Need to test effect on more than one type of bacteria

7) HYPOTHESIS THAT THE LOWER THE PH OF THE DRINK THE FASTER A TOOTH WILL DECAY

A) SAFETY AND ETHICAL ISSUES

Need to avoid potential source of bacterial infection

Risk due to body fluids

Risk due to use of strong acids

Risk due to sterilisation technique

Consent from donors

B) PRELIMINARY WORK

Practice proposed method

Check most suitable conditions for decay of teeth

Select suitable timescale of measuring decay rates

Check if the type/age of tooth has an effect

Determine appropriate dependent variable

Check pH of orange juice

C) EXPERIMENT

Dependent variable: time for tooth to decay

Independent variable: variable pH

Range of suitable pH suggested

The proposed range includes the pH of the orange juice

How to measure pH

Time period over which the decay will be measured

Control variables

Repeats

D) RECORDED, PRESENTED AND ANALYSED

Table containing mean mass

Line graph

Spearman's rank

E) LIMITATIONS

Difficult to control all variables affecting decay

Exposure to bacteria, damage teeth

Measuring loss of mass does not necessarily correspond to decay rate

Controlled conditions do not represent natural decay conditions in the mouth

8) INVESTIGATION TO TEST THE FOLLOWING HYPOTHESIS ‘THE HIGHER THE CONCENTRATION A PLANT REGULATOR, THE FASTER THE RATE OF GROWTH OF THE PLANT TISSUE’.

A) SAFETY ISSUES

Tissue culture may provide good growing conditions for bacteria

Possibility of an allergic reaction to the plant growth regulators

Release of GMOs into environment

Use of sharp instruments

Other sensible risk

B) PRELIMINARY WORK

Practice proposed method

Determine appropriate dependent variable

Check most suitable conditions for growth of plant tissue

Select suitable timescale for measuring growth rates

Consider what other variable need to be taken in to account

Range of Concentration

C) EXPERIMENT

Dependent variable: percentage change in mass of plant tissue

Independent variable: concentration of plant growth regulator (at least 5 conc.)

Need to grow on nutrient gel, aseptic condition

Time period

2 Controlled variables

Need for repeats at each concentration

Control of source of plant tissue

D) RECORDED, PRESENTED AND ANALYSED

Line graph

Spearmann's Correlation

E) LIMITATIONS

Difficult to control all variables affecting fissure

Uncontrolled variable e.g. exposure to bacteria

Damage of plant tissue during preparation may affecting growth

Other variable as limiting factor

More than one type of plant growth regulator for effective growth

Difficulty of proposed technique

9) PLAN AN INVESTIGATION TO TEST WHETHER THESE SUBSTANCES INHIBIT THE EFFECT OF PERFORIN.

A) SAFETY AND ETHICAL ISSUES

Allergen, irritant, damage to human all membranes of perforin

Safety risk linked to equipment e.g. use of sharp blade

There is no significant ethical issues

B) PRELIMINARY WORK

Practicing proposed method to see if it works

Finding appropriate concentration of perforin

Finding appropriate temperature for perforin activity

Determining appropriate size of tissue

Determining a named detail in the measurement of dependent variable

Finding appropriate timescale for perforin to work

C) EXPERIMENT

Independent variable is the presence of substances A-E

Dependent variable is the activity of perforin

Preparing tissue before use (after cutting)

5 separate tests involving substances A-E, perforin and tissue in a sensible order

Use of control with perforin and tissue but no inhibitor

Ensuring solution is well mixed to disperse pigment

Control variable

Repeats

D) LIMITATIONS

It is difficult to control (all) variables affecting colour of the solution

Variation in tissue used (pigment content)

Membrane damage not due to perforin

Difficulty of measuring dependent variable

Only one type of perforin tested

10) PLAN AN INVESTIGATION TO DETERMINE WHICH PART OF THIS PLANT IS THE BEST SOURCE OF THE INHIBITOR.

A) SAFETY AND ETHICAL ISSUES

There are no significant ethical issues

Enzymes or plant material may be irritants

B) PRELIMINARY WORK

Trialling method to see if it works

Determine suitable extraction method for the inhibitors

Determine suitable source of starch

Determine suitable conditions for the enzyme activity

Determine suitable method for detecting presence of starch

C) EXPERIMENT

Independent variable: Different parts of plants

Obtaining tissue extract through homogenesation with solvent

Appropriate experimental design involving starch + amylase + each tissue

Control involving starch + amylase and no tissue

Dependent variable: amylase activity

Method to obtain rate of reaction

Control variable

Repeats

D) LIMITATIONS

Difficult to control all variables affecting amylase activity

Specific point relating to difficulty of measuring that dependent variable

Limitation linked to inhibitor extraction

Different inhibitors present in different parts of plants

Some parts of plant may contain amylase

Plants used may not be representative of pigeon pea plants in general